9/10/02   Summary Mini ESA Results

Fig. 1, Pro-Engineer drawing, Cross-section of Mini ESA Tophat Analyzer (note: electrodes are white)

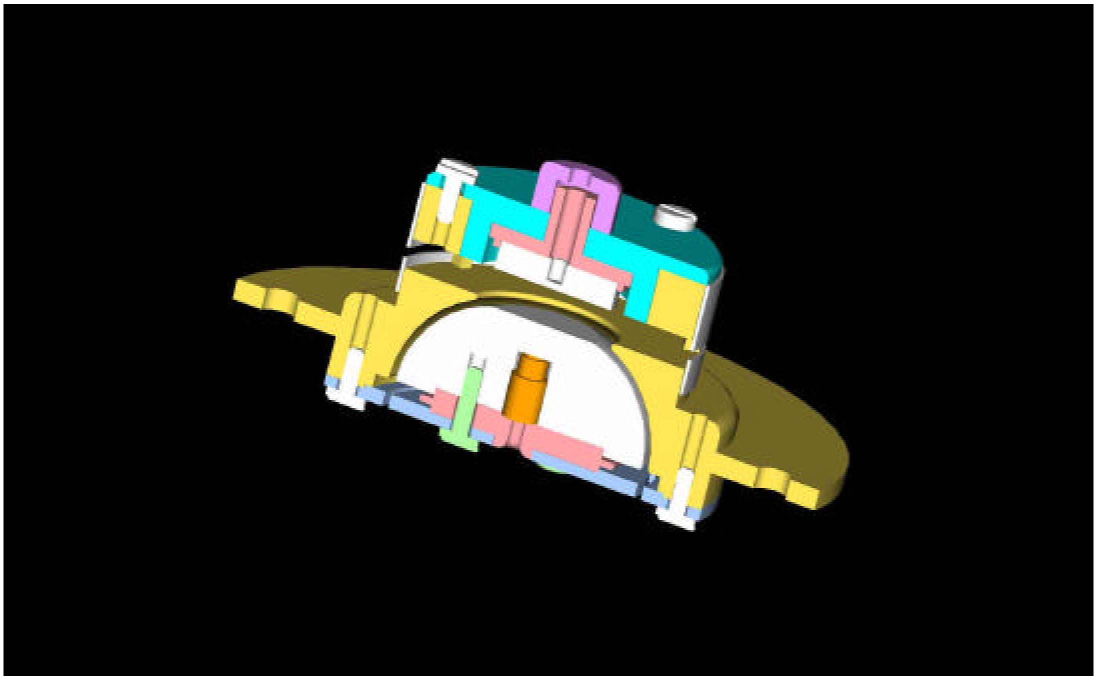


Fig. 2, Individual components (Gold Plated Aluminum)

Fig 3, Assembled Mini ESA, Side View

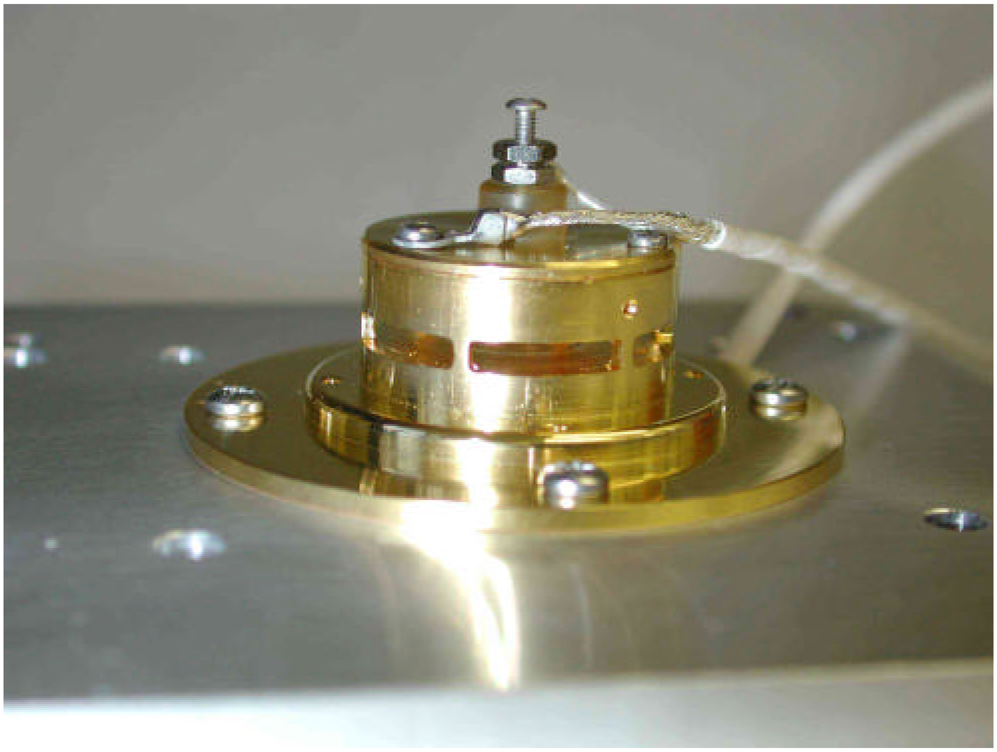
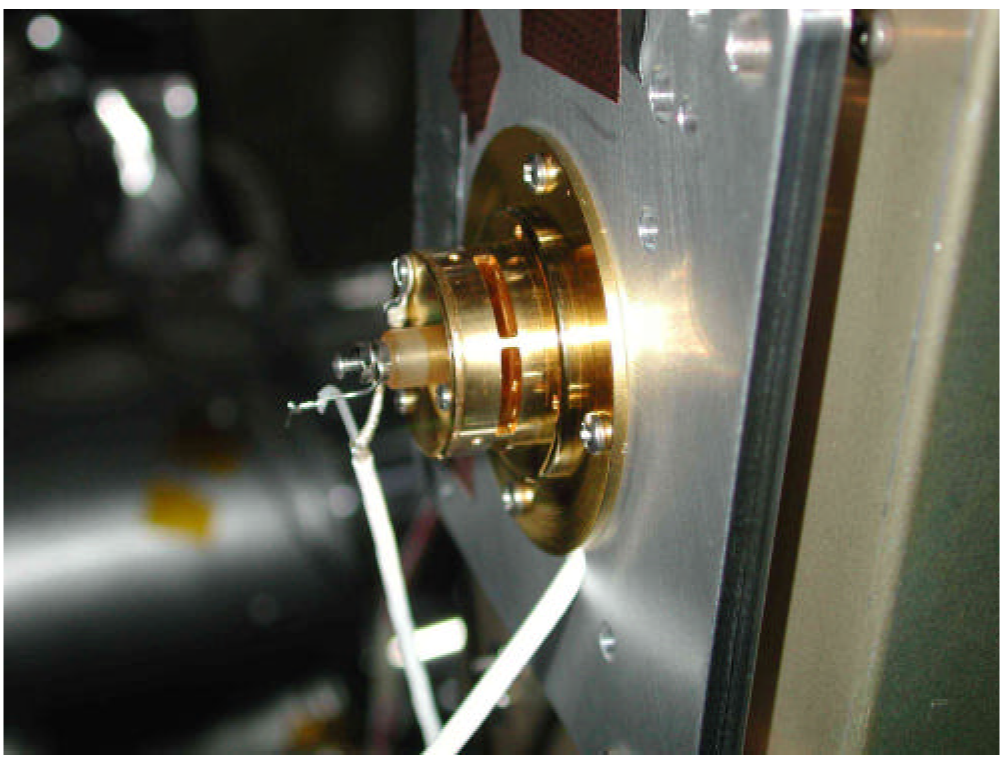


Fig. 4, Mounted on Quantar Imaging detector, in Vacuum Chamber



Other images may be found at http://ipb.gsfc.nasa.gov/spil/Mini_ESA/

Fig. 5, Typical Energy/Angle coupling in Top-Hat analyzers.

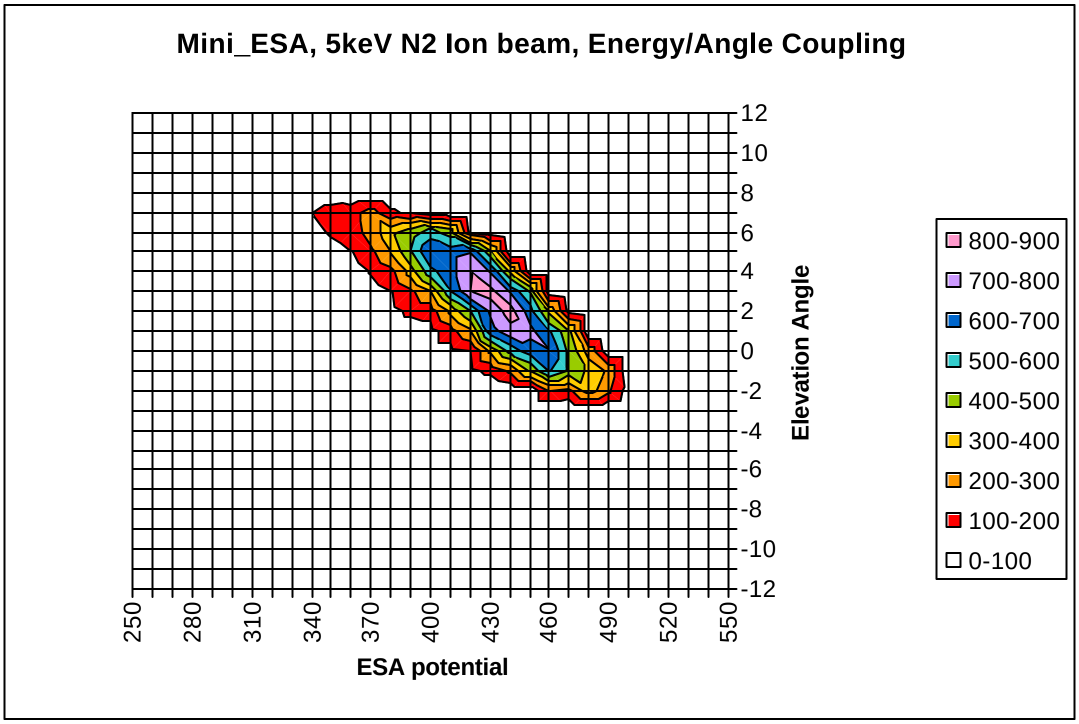
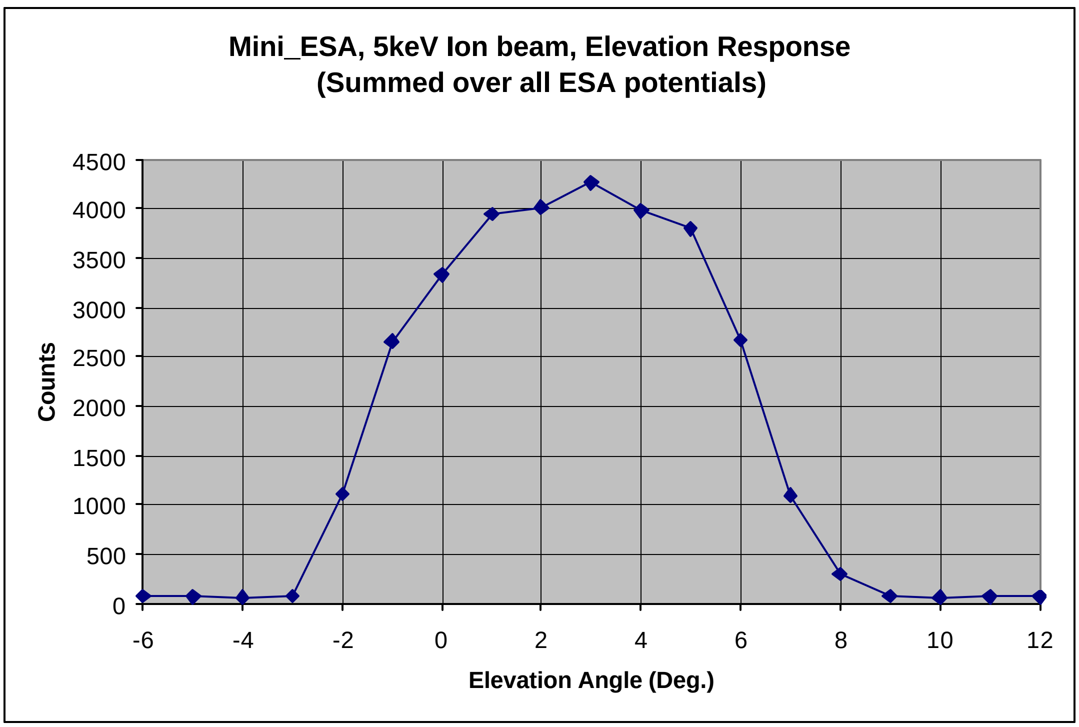


Fig. 6, Elevation acceptance Angle = 7 Deg.. FWHM, (center of FOV is 2.5 Deg above "equator")



fig

Fig, 7, Energy resolution dE/E = 0.176, Analyzer Const = 11.76

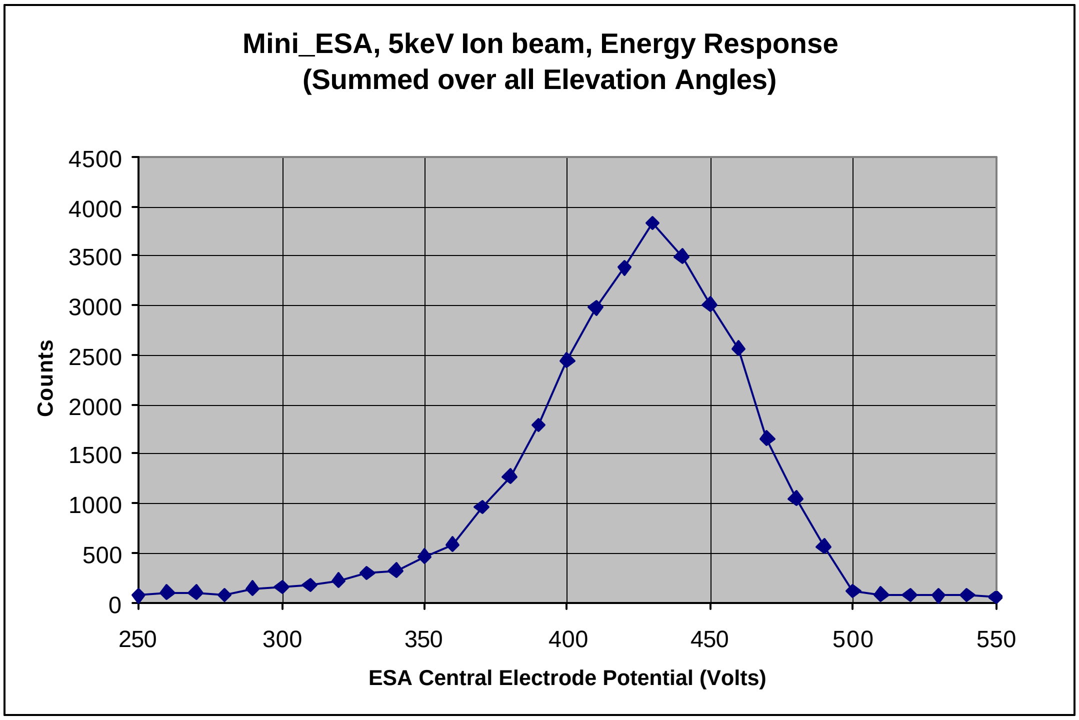


Fig. 8, Investigation of Effect of Potential on Top Electrode. (~+150 Volts centers the FOV about 0 Deg. This represents a 35% increase in the electric field, which could equivalently be obtained by reducing the gap between the electrodes from 2.62mm to 1.7mm)

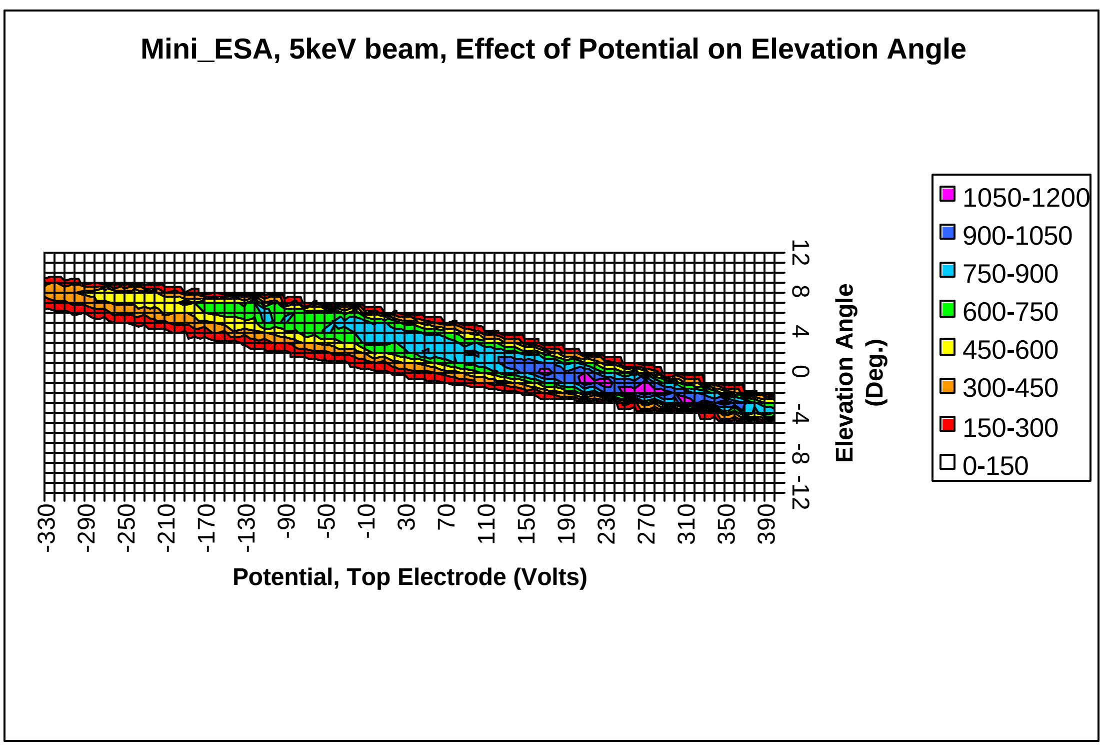


Fig. 9, Response as a Fn. of Elevation (Summed over all Top Electrode Potentials)

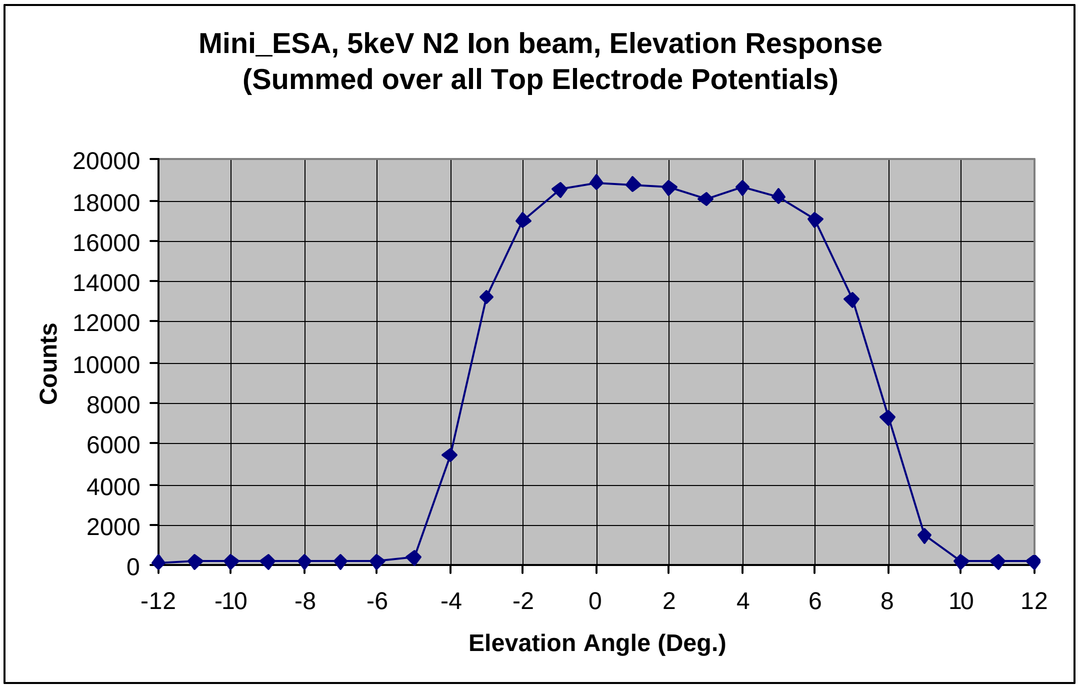


Fig. 10, Response as a Fn. of Top Electrode Potential, (Summed over all Elevation angles)

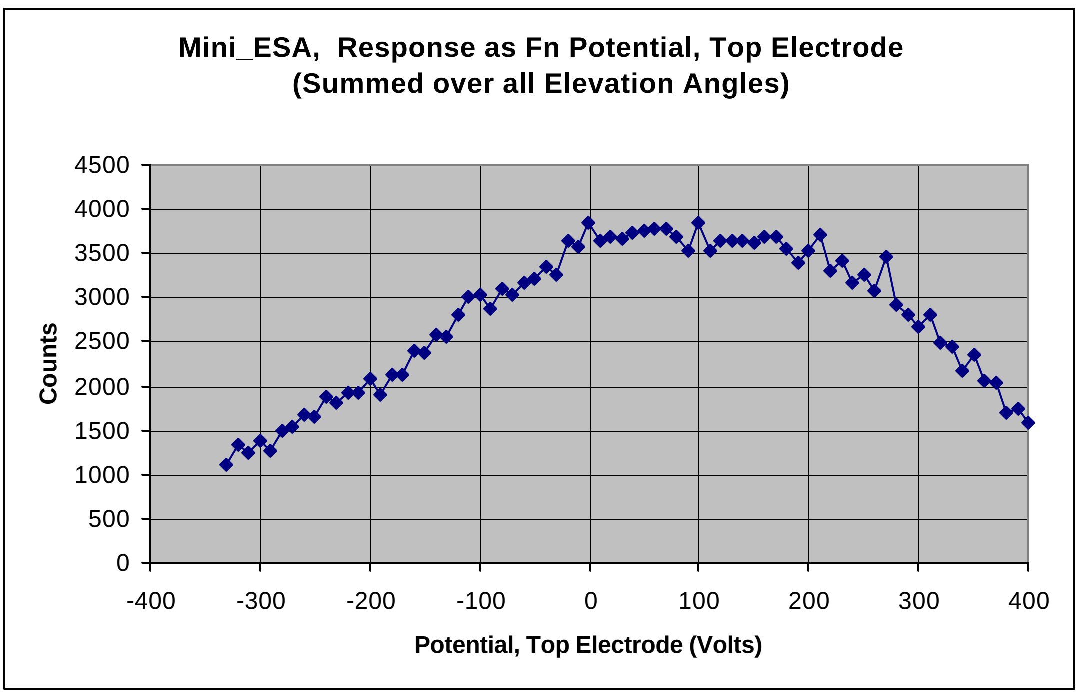


Fig. 11, Plot showing results from SIMION Ray Tracing Run

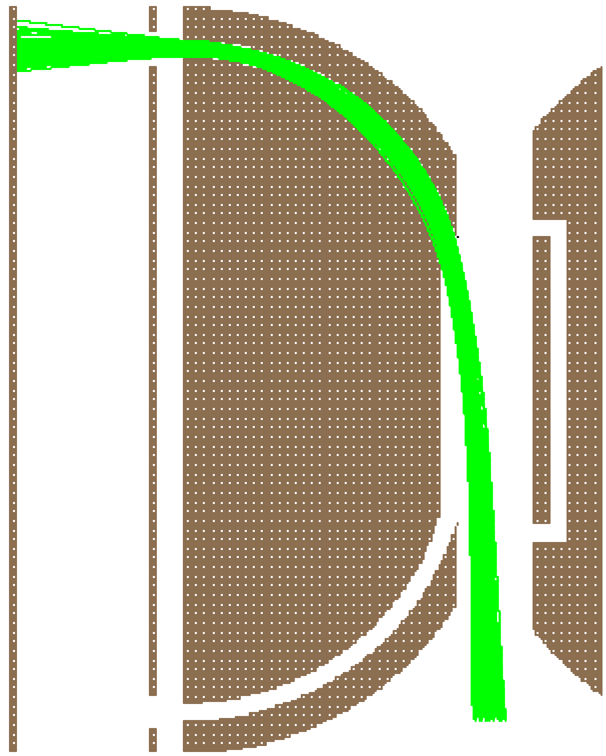


Fig. 12, Here equipotential contours are show. The greatest electric field is due to the “knife edge” defining the entrance to the ESA.

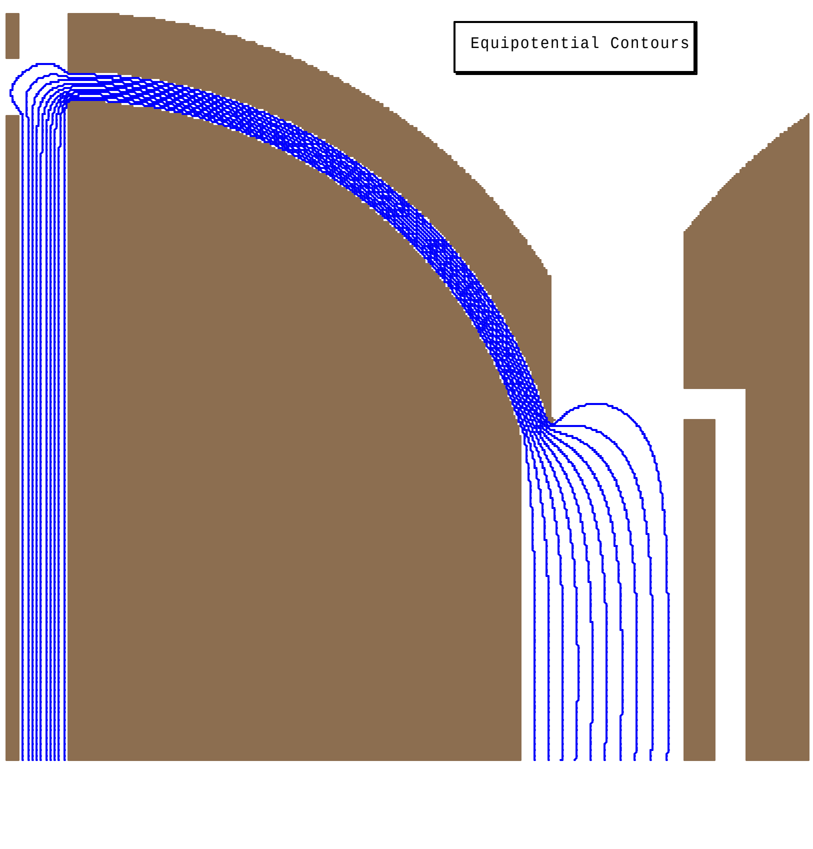
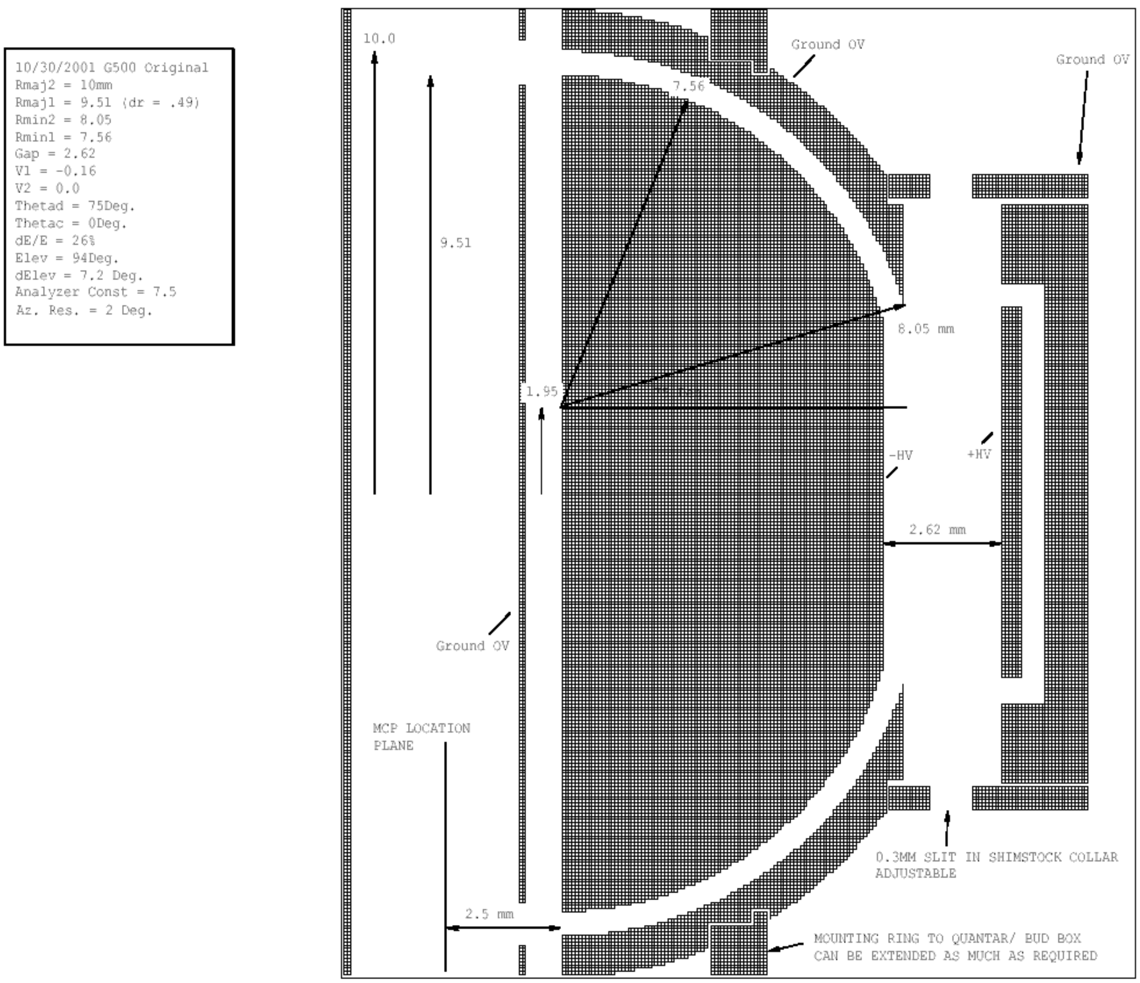


Fig. 13, Plot created with SIMION to show Mini ESA dimensions



Notes:

1) In linear terms the Mini ESA is just over a factor of 10 smaller than the Young analyzer.

2) From the ratio of the measured value for the analyzer const (11.76) to that expected (7.5), we deduce that the gap dR is closer to 0.32mm rather than 0.49mm.

3) Using a beam of known intensity, as determined with a second quantar imaging detector, we deduced that the effective area of the entrance aperture is ~ 0.6mm^2. This is about a factor of 2 smaller than expected (1.3mm^2) from the Young paper. From the above, we deduce that the measured geometric factor is of order 3.9e-5 cm^2 sr eV/eV per 20 Deg. Azimuthal pixel.

4) The top electrode was incorporated to compensate for errors in the top gap due to tolerance build up. The affect of a different gap here, would be to pass trajectories from a different elevation in to the ESA gap. What actually occurred was that since the analyzer constant was significantly greater than designed, ions that made it through the ESA had a higher energy than expected, and so the e-field in the top gap was not sufficient to pass ions at zero elevation into the ESA. Increasing the field by ~35% accomplished this, see Fig. 8.

5) High Voltage testing, the central electrode potential was raised to +5kV. It sat here for ~1.25hrs without any arc-overs occurring during this time. (Note: this would corresponds to 58.8keV ions !). The potential was then increased in 1kV increments every ~10 minutes till arcing or breakdown occurred with 8kV on the central electrode. (Note: we used 15kV feedthroughs and cable, so we were sure that this took place at the analyzer).

Table 1. Comparing Mini ESA results, with those presented by D. Young et al in their paper "2Pi radian field-of-view toroidal electrostatic analyzer, Rev. Sci. Instrum. 59, May 1988", and from SIMION Ray Tracing Experiments.

Torroidal Tophat Geometric Parameters (mm)	**Young's Actual Results**	**Mini_ESA Ray Tracing Experimet**	**Mini_ESA Actual Experiment**	**Notes:**
R_major_2	102.50	10.000	10.000	
R_major_1	97.50	9.510	9.510	
Overall Diameter		22.000	22.000	
R_minor_2	82.50	8.050	8.050	
R_minor_1	77.50	7.560	7.560	
dR	5.00	0.490	0.490	
R/dR	16.00	15.929	15.929	
Lid_Gap	24.40	2.620	2.620	
ThetaD Deg.	75.00	75.000	75.000	
ThetaC Deg.	0.00	0.000	0.000	
Results				
dE/E %	0.18	**0.177**	**0.176**	Good agreement
Elev. Resn. Deg.	7.60	**7.200**	**7.000**	Good agreement
Az. Res.	1.00	**2.000**	**20.000**	Detector not at optimum distance from ESA exit for high Azimuth resolution
Analyzer Const.	8.20	**7.500**	**11.760**	Gap probably smaller than designed due to tolerance and/or Gold plating build up
Next Line, enter Volts/mil to use 40				
40				
Max Energy		5,880	9,220	
HV PS Required		784	784	